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Madle

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(54) **MICROWAVE CAVITY RESONATOR**

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H01P 7/06 (2006.01)
H01P 1/208 (2006.01)

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(58) **Field of Classification Search**
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(Continued)

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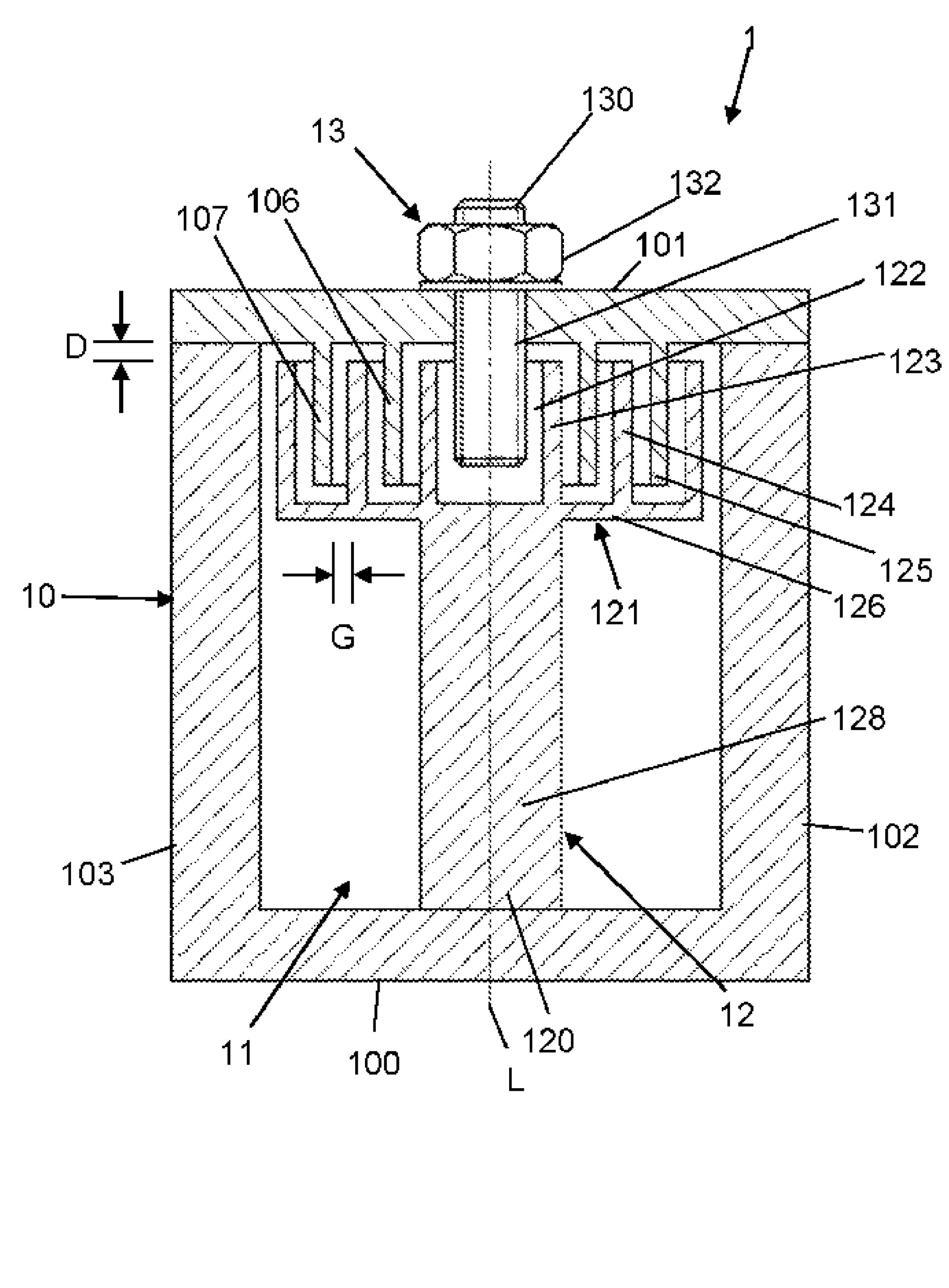
(57) **ABSTRACT**

One embodiment is directed to a microwave cavity resonator comprises a cavity housing forming a cavity. A resonator element is arranged in the cavity and extends longitudinally along a longitudinal axis, wherein the resonator element comprises, when viewed along the longitudinal axis, a first end connected to a first housing wall and a second end opposite the first end, the second end being arranged at a distance from a second housing wall. The resonator element, at its second end, comprises at least one first capacitor element and the cavity housing comprises at least one second capacitor element reaching into the cavity and arranged at a distance, when viewed along a direction perpendicular to the longitudinal axis, from the at least one first capacitor element such that a gap between the at least one first capacitor element and the at least one second capacitor element is formed.

16 Claims, 5 Drawing Sheets



(58) **Field of Classification Search**
USPC 333/208, 209, 222, 223, 227, 231, 232, 333/233
See application file for complete search history.

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Fig. 1A

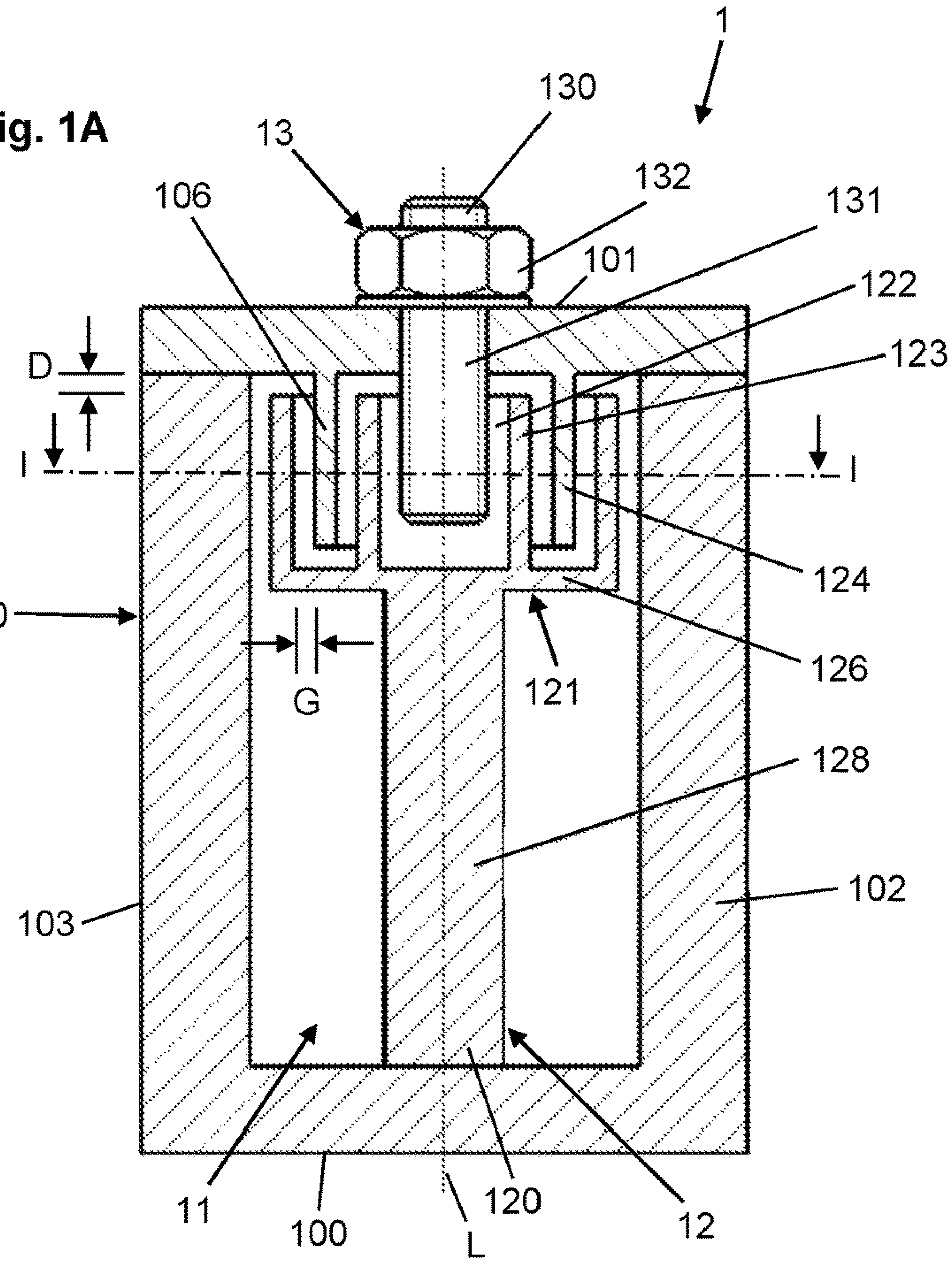


Fig. 1B

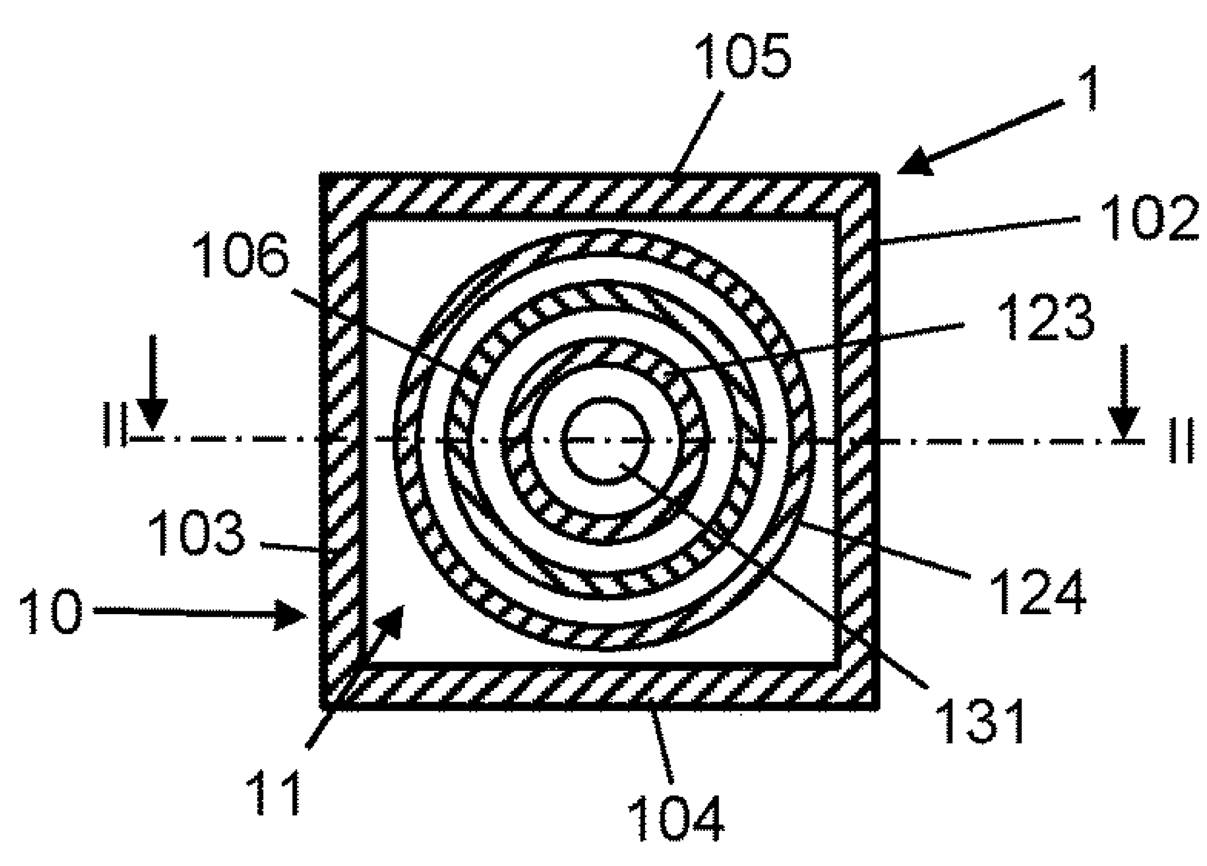


Fig. 1C

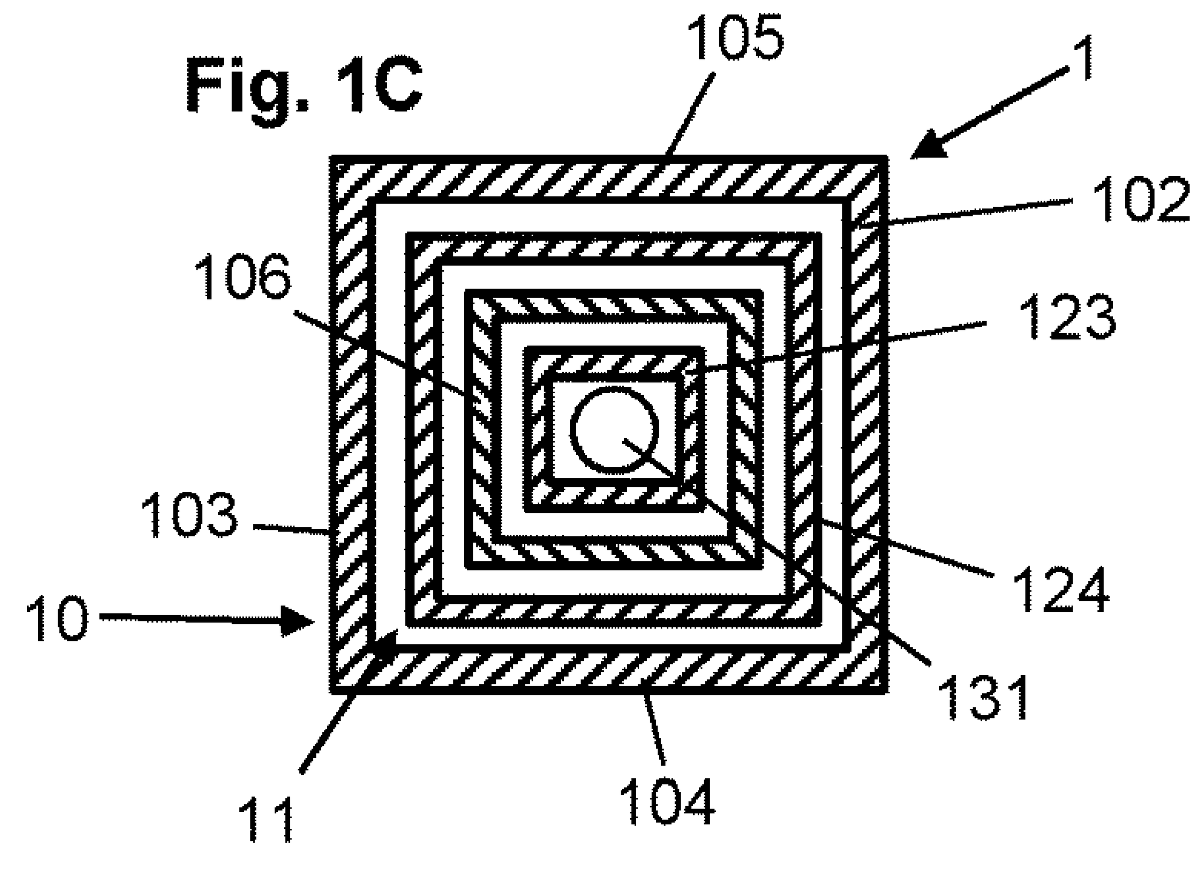


Fig. 2

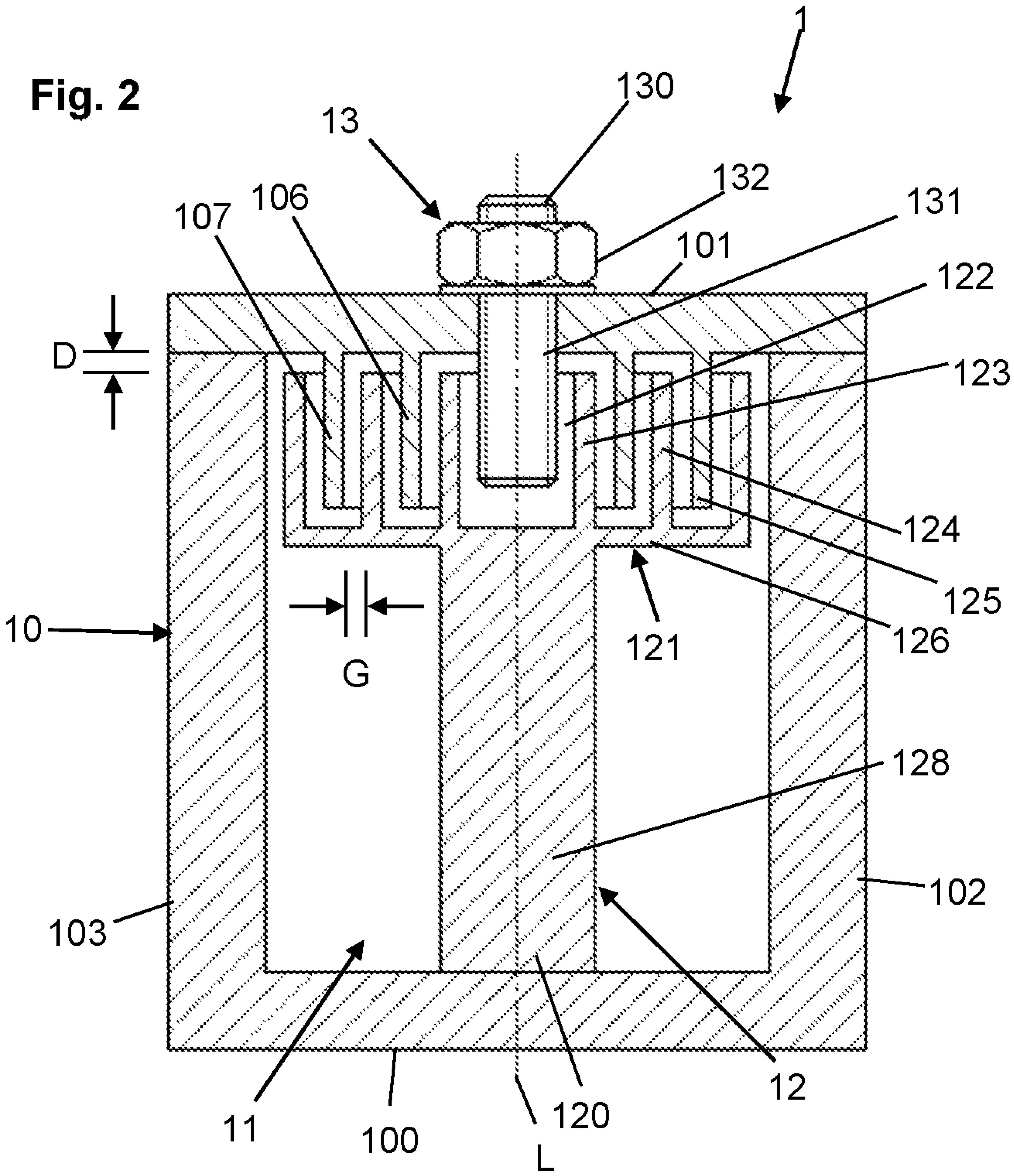

1
130
13
132
131
101
122
107
106
123
D
124
125
121
126
10
G
128
102
103
12
11
100
120
L

Fig. 3A

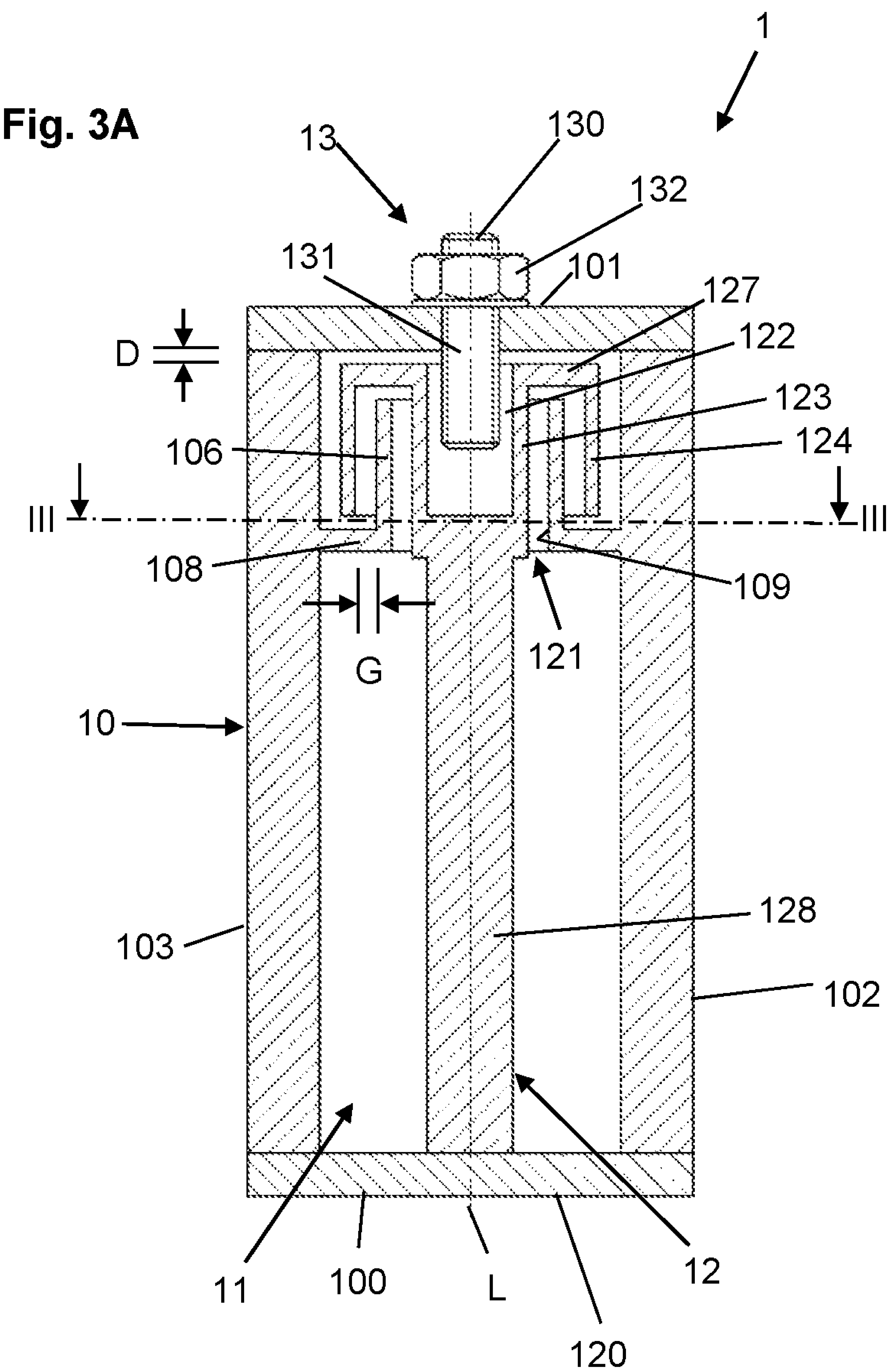

1
13
130
132
131
101
127
122
123
124
D
106
III
III
108
109
G
121
10
128
103
102
11
100
L
12
120

Fig. 3B

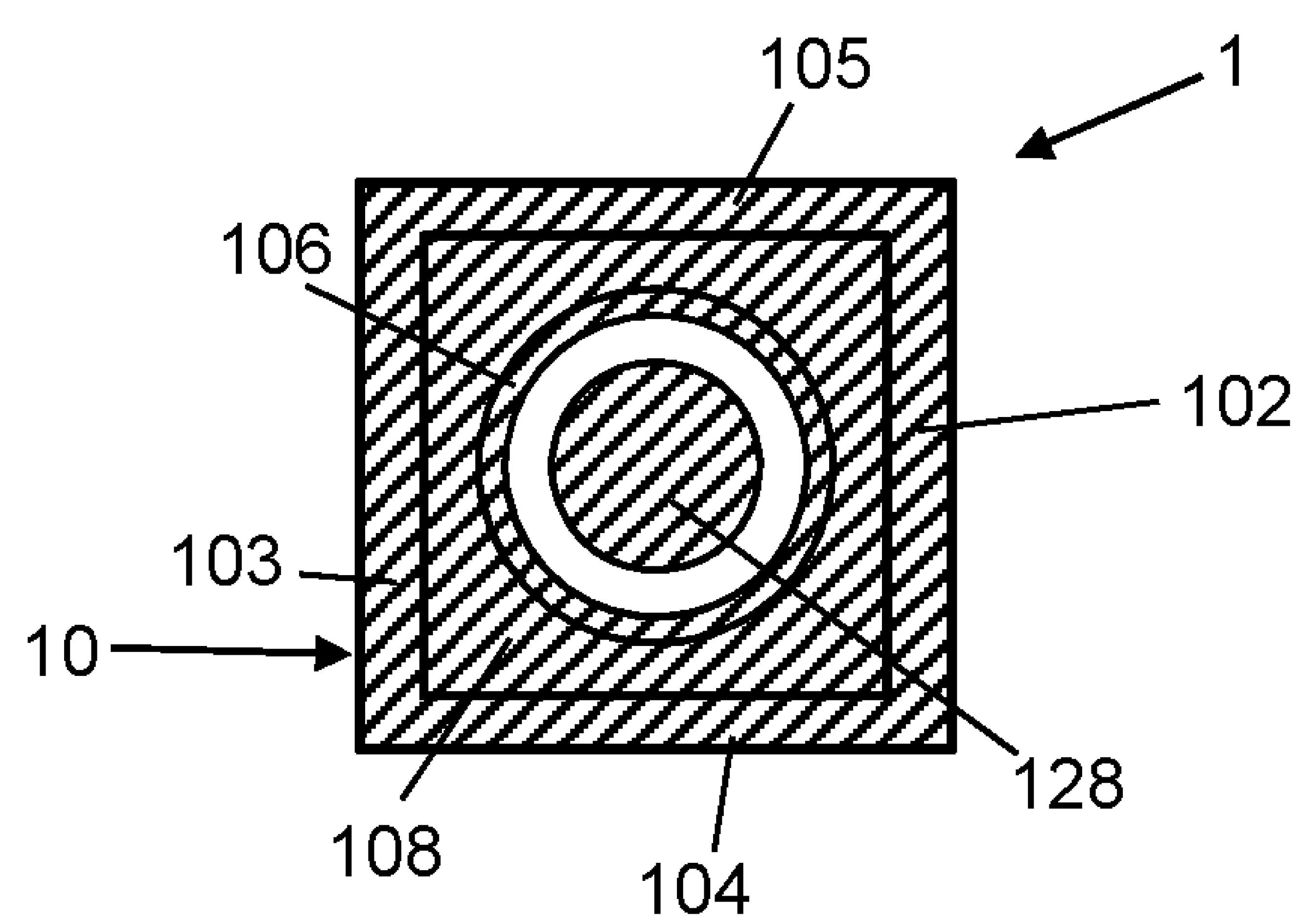

105
1
106
102
103
10
128
108
104

Fig. 4A

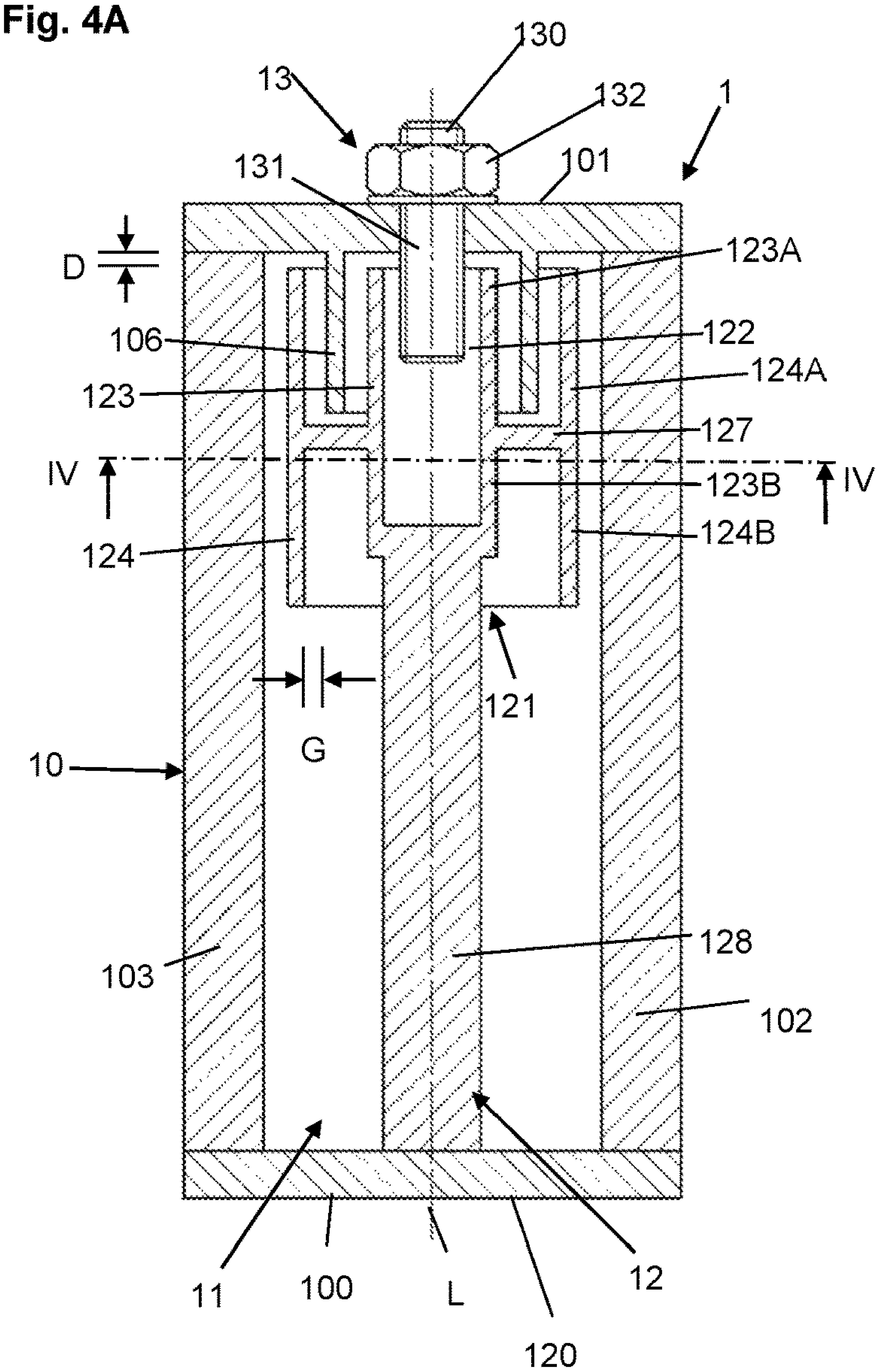

130
13
132
1
131
101
D
123A
106
122
124A
123
127
IV
IV
123B
124
124B
121
G
10
128
103
102
11
100
L
12
120

Fig. 4B

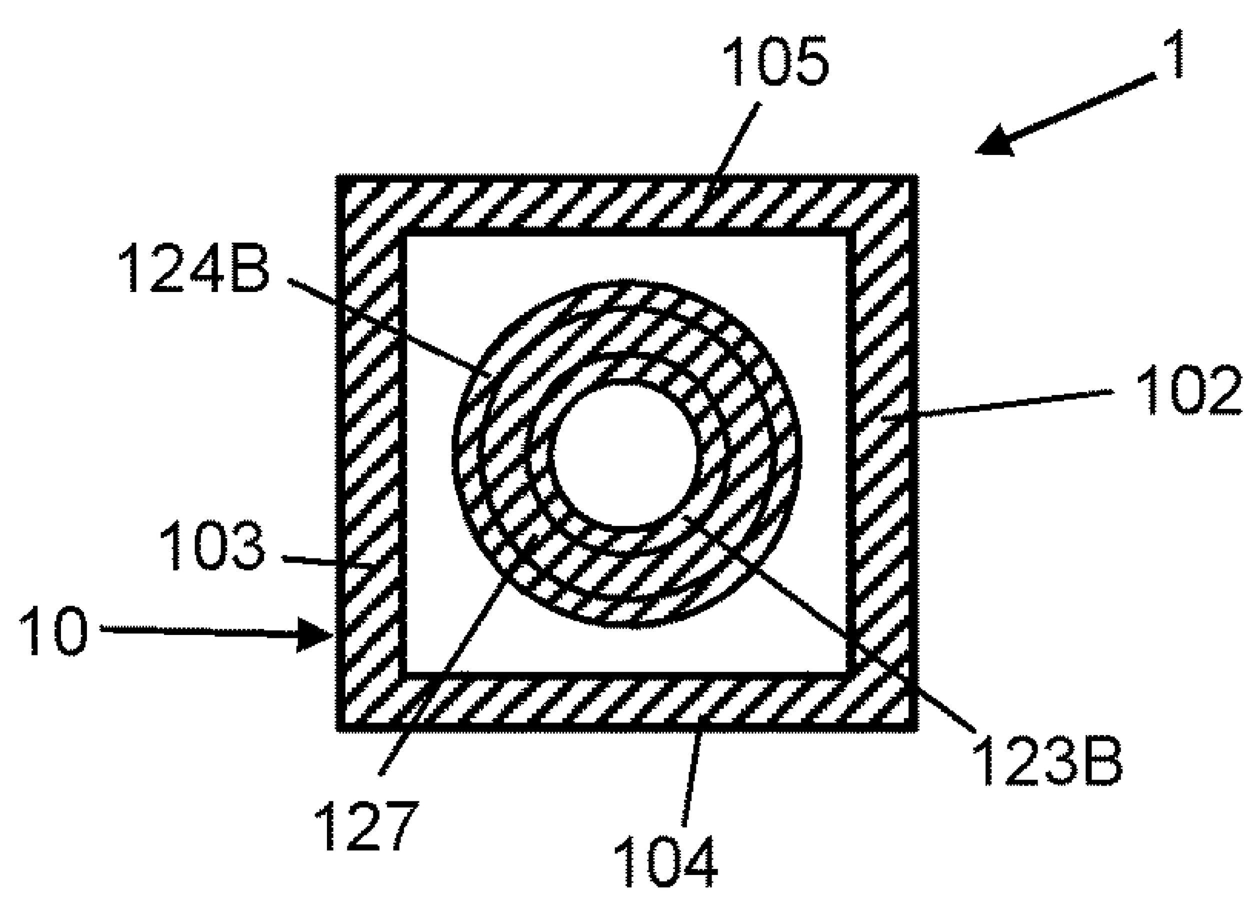
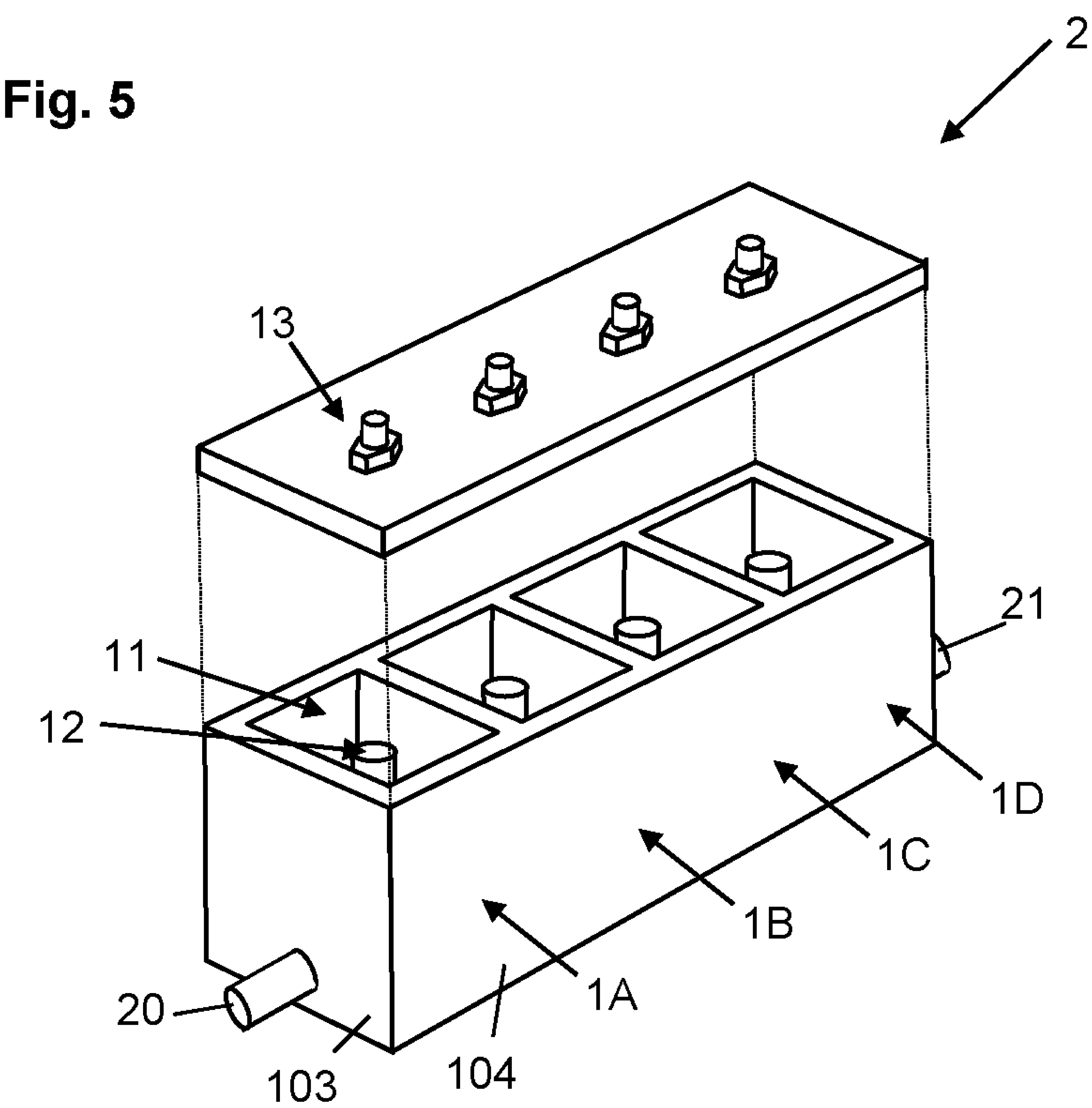

105
1
124B
102
103
10
123B
127
104

Fig. 5



MICROWAVE CAVITY RESONATOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a U.S. National Stage application of PCT Application Serial No. PCT/EP2015/057226, filed Apr. 1, 2015, which claims the benefit of EP Patent Application Serial No. 14163187.9, filed Apr. 2, 2014, the contents of all of which are hereby incorporated by reference.

BACKGROUND

This disclosure relates to a microwave cavity resonator.

A microwave cavity resonator of this kind comprises a cavity housing forming a cavity, the cavity housing comprising a first housing wall and a second housing wall opposite the first housing wall. A resonator element is arranged in the cavity and extends longitudinally along a longitudinal axis. The resonator element comprises, when viewed along the longitudinal axis, a first end connected to the first housing wall and a second end opposite the first end, the second end being arranged at a distance from the second housing wall.

A microwave cavity resonator of this kind may for example be used in a microwave filter, for example a band pass filter or a band stop filter, in a multiplexer or in another radiofrequency (RF) device.

A microwave filter including multiple cavity resonators is for example known from U.S. Pat. No. 6,735,766. A resonator element placed within a cavity of a cavity resonator is herein attached with its first end to a bottom wall of a cavity housing and with a second end is arranged at a distance from a housing cover opposite the bottom wall. The second end of the resonator element hence represents an open end which is not connected to the housing cover.

Within a cavity resonator of this kind the resonator element comprises an electrical length of a quarter wavelength at the resonant frequency of the cavity resonator. This poses a limit for the dimensions of such cavity resonators, which may be in contrast to a desire for a miniaturization and for low production costs.

It has been proposed to place a capacitor element at the second, open end of the resonator element in order to increase the capacitance in-between the second, open end of the resonator element and the surrounding cavity housing. This allows to shorten the resonator element.

In EP 1 118 134 B1 a cavity resonator is described in which discs are placed in the vicinity of the second, open end of the resonator element, the discs electrically interacting with plates on the cavity housing in order to increase the capacitance in-between the second, open end of the resonator element and the cavity housing.

There is a desire to increase the capacitance between the second, open end of the resonator element and the surrounding cavity housing further. Herein, in known solutions, it is necessary to arrange the second end of the resonator element with respect to the surrounding housing such that a relatively small gap in-between the second end of the resonator element and one or multiple housing walls of the housing is obtained. Such arrangements are sensitive to tolerances and sometimes are mechanically and electrically unstable over the operational range of temperatures.

From U.S. Pat. No. 3,448,412 a miniaturized tunable resonator is known in which a movable assembly, together with a cylindrical member, forms a structure similar to a folded coaxial line and hence a resonator within a cavity.

SUMMARY

In one example, a microwave cavity resonator is provided that allows for decreasing the dimensions of the cavity resonator while at the same time exhibiting a mechanically and electrically stable behavior and having a high quality (Q) factor.

This can be achieved, for example, with a microwave cavity resonator comprising a cavity housing forming a cavity, the cavity housing comprising a first housing wall and a second housing wall opposite the first housing wall. The microwave cavity also comprises a resonator element arranged in the cavity and extending longitudinally along a longitudinal axis, wherein the resonator element comprises, when viewed along the longitudinal axis, a first end connected to the first housing wall and a second end opposite the first end, the second end being arranged at a distance from the second housing wall. The resonator element, at its second end, comprises at least one first capacitor element and the cavity housing comprises at least one second capacitor element reaching into the cavity and arranged at a distance, when viewed along a direction perpendicular to the longitudinal axis, from the at least one first capacitor element such that a gap between the at least one first capacitor element and the at least one second capacitor element is formed.

One example starts from the idea to provide one or multiple first capacitor elements at the second, open end of the resonator element. Such first capacitor elements on the second end of the resonator element are associated with one or multiple second capacitor elements on the housing of the cavity resonator such that a capacitance in-between the one or the multiple first capacitor elements and the one or multiple second capacitor elements is formed.

By increasing the capacitance in-between the second, open end of the resonator element and the cavity housing, it becomes possible to shorten the length of the resonator element below the required electrical length of a quarter wavelength in a quarter-wavelength resonator. The physical length of the resonator element can hence be decreased below a quarter wavelength while maintaining the electrical length of the resonator element at a quarter wavelength.

The at least one first capacitor element (arranged on the second, open end of the resonator element) and the at least one second capacitor element (arranged on the housing) are placed with respect to one another such that a gap is formed in-between the capacitor elements. Herein, the at least one first capacitor element and the at least one second capacitor element are displaced with respect to each other in a direction perpendicular to the longitudinal axis along which the resonator element extends. In particular, the at least one first capacitor element and the at least one second capacitor element may be arranged coaxially to each other such that a second capacitor element arranged on the housing surrounds a first capacitor element arranged on the second, open end of the resonator element circumferentially about the longitudinal axis.

The at least one first capacitor element and the at least one second capacitor element for example may have a cylindrical shape, wherein the at least one first capacitor element and the at least one second capacitor element are arranged coaxially with respect to each other. Multiple first capacitor elements herein may intermesh with multiple second capacitor elements such that an intermeshed arrangement of capacitor elements is obtained.

The shape of the at least one first capacitor element and the at least one second capacitor element, however, is not limited to a cylindrical shape. Just as well, the at least one first capacitor element and the at least one second capacitor element can have a quadratic or rectangular shape (when viewed in cross section in a crosssectional plane perpendicular to the longitudinal axis).

In particular, when having multiple first capacitor elements intermesh with multiple second capacitor elements, one second capacitor element is arranged spatially in-between two first capacitor elements and one first capacitor element is arranged spatially in-between two second capacitor elements. When viewed in a direction perpendicular to the longitudinal axis, hence, a first capacitor element connected to the second, open end of the resonator element is followed by a second capacitor element connected to the housing, which again is followed by a first capacitor element connected to the second, open end of the resonator element, and so on. In-between the different capacitor elements a gap is formed such that a capacitance between the capacitor elements is provided.

The at least one second capacitor element, in one embodiment, may be arranged on the second housing wall. The at least one second capacitor element hence is connected to the second housing wall of the cavity housing opposite the first housing wall to which the resonator element is connected with its first end. The at least one second capacitor element extends from the second housing wall and reaches into the cavity along the longitudinal axis such that a gap is formed between the at least one second capacitor element on the second housing wall and the at least one first capacitor element on the second, open end of the resonator element.

In another embodiment, the at least one second capacitor element may be arranged on a side wall of the cavity housing extending in-between the first housing wall and the second housing wall. From the side wall the at least one second capacitor element reaches into the cavity, wherein the at least one second capacitor element may for example be connected to the side wall via a base such that the at least one second capacitor element is arranged coaxially to the resonator element at a distance from the side wall of the cavity housing.

Multiple first capacitor elements, in one embodiment, are connected to the second, open end of the resonator element via a first base extending in a plane perpendicular to the longitudinal axis. The first base is attached to the resonator element in the vicinity of the second, open end of the resonator element and carries the multiple first capacitor elements, wherein the multiple first capacitor elements are arranged coaxially with respect to each other.

In another embodiment, multiple first capacitor elements may be connected to each other via a first base extending along a plane perpendicular to the longitudinal axis, wherein the connection to the resonator element is provided via for example the innermost first capacitor element, but not the base.

From the first base, the multiple first capacitor elements may extend towards the second housing wall and/or towards the first housing wall. If the multiple first capacitor elements are arranged coaxially with respect to each other, they may for example be connected to each other via the first base at a side of the multiple first capacitor elements facing away from the second housing wall in which case the multiple first capacitor elements extend from the base towards the second housing wall. Or the base may be arranged at a side of the first capacitor elements facing the second housing wall in which case the multiple first capacitor elements extend from the base towards the first housing wall.

A portion of at least one first capacitor element can extend from the first base towards the second housing wall, whereas a second portion of the at least one first capacitor element extends from the first base towards the first housing wall. A first portion of the at least one first capacitor element hence is arranged on the base to protrude towards the second housing wall, whereas a second portion points towards the first housing wall and hence in an opposite direction.

In one embodiment, multiple second capacitor elements are connected to each other via a second base extending along a plane perpendicular to the longitudinal axis. Multiple second capacitor elements connected to the housing hence are carried by a common, second base. Via the second base the second capacitor elements may for example be connected to a side wall or the second housing wall of the housing.

In one embodiment, a tuning device is arranged at the second housing wall, the tuning device having a shaft extending into the cavity along the longitudinal axis. The shaft is arranged coaxially to the resonator element and is adjustable in its position along the longitudinal axis in order to tune the microwave cavity resonator. The tuning device may for example be embodied as a tuning screw which with its shaft can be screwed into or screwed out of the cavity such that the length of the shaft reaching into the cavity may be adjusted. The shaft of the tuning device may, in particular, be arranged coaxially to the at least one first capacitor element and the at least one second capacitor element, wherein the at least one first capacitor element and the at least one second capacitor element are positioned radially outside of the shaft and extend around the shaft.

The cavity housing may for example be fabricated out of a metallic first material, for example aluminum. The resonator element, in contrast, may for example be made of a different, second material, for example brass, wherein it also is conceivable to form the resonator element from a non-metallic material, for example a ceramic material.

It also is conceivable to produce the cavity housing and/or the resonator element from a metalized plastic material, for example a plastic having a metal coating.

DRAWINGS

FIG. **1**A shows a cross-sectional view of a microwave cavity resonator along line II-II according to FIG. **1**B;

FIG. **1**B shows a cross-sectional view of the microwave cavity resonator along line I-I according to FIG. **1**A;

FIG. **1**C shows a cross-sectional view of a modified embodiment of a microwave cavity resonator;

FIG. **2** shows a cross-sectional view of a different embodiment of a microwave cavity resonator;

FIG. **3**A shows a cross-sectional view of yet another embodiment of a microwave cavity resonator;

FIG. **3**B shows a cross-sectional view along line III-III according to FIG. **3**A;

FIG. **4**A shows a cross-sectional view of yet another embodiment of a microwave cavity resonator;

FIG. **4**B shows a cross-sectional view along line IV-IV according to FIG. **4**A; and

FIG. **5** shows a schematic view of a microwave filter comprising multiple cavity resonators.

DESCRIPTION

A microwave filter **2**, as it is schematically shown in FIG. **5**, comprises multiple cavity resonators **1**A, **1**B, **1**C, **1**D arranged in a common cavity housing **10**. Each cavity resonator **1**A, **1**B, **1**C, **1**D comprises a cavity **11** in which a resonator element **12** is located. The cavity housing **10** comprises housing walls **103**, **104** and a housing lid **101** and fully encloses the cavity **11** of the multiple cavity resonators **1**A, **1**B, **1**C, **1**D.

A microwave filter **2**, as schematically shown in FIG. **5**, may for example be employed in wireless communication devices and may for example implement a bandpass or bandstop filter. Such microwave filters **2** comprising multiple cavity resonators **1**A, **1**B, **1**C, **1**D shall in general exhibit a high quality (Q) factor leading to a low insertion loss. Further, such microwave filters **2** shall be mechanically and electrically stable and be operable over a wide range of temperatures.

Within such microwave filter **2**, a radio frequency (RF) signal is fed into an input port **20** and passes through the microwave filter **2** to an output port **21**. Dependent on the design of the microwave filter **2**, RF signals in a predefined frequency band are passed (bandpass filter) or suppressed (bandstop filter).

Within the cavity **11** of the single cavity resonators **1**A, **1**B, **1**C, **1**D, which suitably are electromagnetically coupled for example via openings in the inner housing walls in between the cavities **11** of the cavity resonators **1**A, **1**B, **1**C, **1**D, resonator elements **12** in the shape of longitudinally extending rods are placed. Such resonator elements **12** with a first end **120** (see for example FIG. **1**A) are connected to a first, bottom housing wall **100** of the housing **10** and extend within the associated cavity **11** along a longitudinal axis L towards a second, top housing wall **101** formed by the housing lid opposite the first housing wall **100**. The resonator element **12**, together with the cavity housing **10** forming the cavity **11**, forms a quarter-wavelength resonator and has an electrical length of a quarter wavelength (at a specified resonant frequency).

The second end **121** opposite the first end **120** of the resonator element **12** herein is not connected to the second housing wall **101** and hence is electrically opened.

In order to shorten the physical length of the resonator element **12** below its electrical length of a quarter wavelength, in the embodiment of FIG. **1**A capacitor elements **123**, **124** in the shape of cylindrical rings (see FIG. **1**B) or quadratic or rectangular elements (see FIG. **1**C) are arranged at the second end **121** and intermesh with a capacitor element **106** attached to the second, top housing wall **101** of the cavity housing **10**. The capacitor elements **123**, **124** of the resonator element **12** as well as the capacitor element **106** of the second housing wall **101** extend circumferentially about the longitudinal axis L and are arranged coaxially with respect to each other and with respect to the longitudinal axis L. The capacitor element **106** attached to the second housing wall **101** herein reaches into an opening formed in between the capacitor elements **123**, **124** of the resonator element **12** such that a gap G is formed in-between the capacitor elements **123**, **124** of the resonator element **12** and the capacitor element **106** of the second housing wall **101**.

The second end **121** of the resonator element **12** with the capacitor elements **123**, **124** arranged thereon is spaced apart from the upper, second housing wall **101** of the cavity housing **10** by a distance D such that the second end **121** of the resonator element **12** is not electrically connected to the second housing wall **101**. Because the surfaces of the capacitor elements **123**, **124**, **106** can be large, a comparatively large capacitance in-between the second end **121** of the resonator element **12** and the surrounding housing **10**, namely side walls **102**, **103**, **104**, **105** and the top wall **101**, can be provided.

Because the capacitance in-between the second end **121** of resonator element **12** and the surrounding housing **10** can be large, the physical length of the resonator element **12** can be substantially shortened, such that a reduction of the overall dimensions of the cavity resonator **1** becomes possible while at the same time allowing for a high Q factor and low insertion loss of a corresponding microwave filter **2**.

With the design described herein, the gap G in between the capacitor element **106** of the second, top housing wall **101** and the inner capacitor element **123** on the one hand and the outer capacitor element **124** on the other hand of the resonator element **12** can be chosen such that a mechanically and consequently electrically stable behavior of the resonator **1** over a wide range of operational temperatures is obtained. In particular, because the gap G can be chosen relatively large (for example in the range of 1 mm), the resonator **1** can be insensitive to tolerances and hence can be easily manufactured without paying particular attention to tight tolerances.

The capacitor elements **123**, **124** of the resonator element **12** and the capacitor element **106** of the second housing wall **101** extend about the longitudinal axis L in a ring-like coaxial fashion. The capacitor elements **123**, **124** herein are carried by a common base **126** and, via the base **126**, are attached to a shaft **128** of the resonator element **12**. The base **126** is arranged at a side of the capacitor elements **123**, **124** opposite the second housing wall **101** and, together with the capacitor elements **123**, **124**, forms a groove-like opening into with the capacitor element **106** arranged on the second housing wall **101** extends.

The capacitor elements **123**, **124** may be integrally formed with the resonator element **12** and may for example be made of brass.

The capacitor element **106** of the second housing wall **101** may be integrally formed with the second housing wall **101** and may be fabricated, as the entire housing **10**, for example of aluminum.

The radially innermost capacitor element **123** of the resonator element **12** forms an inner, central opening **122**, into which a shaft **131** of a tuning device **13** in the shape of a tuning screw extends. The tuning device **13** is arranged on the second housing wall **101**. The shaft **131** reaches through the second housing wall **101** and is rotatable about the longitudinal axis L such that the length of the shaft **131** extending into the cavity **11** of the cavity resonator **1** along the longitudinal axis L can be adjusted. The shaft **131** is screwed into a screw nut **132** placed on the housing wall **101** and, at an end **130** outside the cavity **11**, can be accessed by using a tool like a screw driver or the like. The shaft **131** is for example made of a metallic material, such as aluminum or brass.

As shown in FIG. **1**B, the capacitor elements **106**, **123**, **124** may have a cylindrical shape extending around the longitudinal axis L and being arranged in a coaxial fashion.

The capacitor elements **106**, **123**, **124**, however, may also have a different shape, for example a quadratic or rectangular shape (when viewed in a cross-sectional plane perpendicular to the longitudinal axis L), as it is illustrated in FIG. **1**C.

Another embodiment of a resonator element **1** is shown in FIG. **2**. In this embodiment, the resonator element **12** carries a base **126** with three coaxial capacitor elements **123**, **124**, **125** attached thereto, the capacitor elements **123**, **124**, **125** being arranged coaxially with respect to each other and extending circumferentially around the longitudinal axis L along which the resonator element **12** extends and. Two capacitor elements **106**, **107** are arranged on the second housing wall **101** of the housing **10**, the capacitor elements **106**, **107** intermeshing with the capacitor elements **123**, **124**, **125** of the resonator element **12** such that a gap G is formed in-between neighboring capacitor elements **106**, **107**, **123**, **124**, **125**.

It is conceivable to increase the number of capacitor elements **123**, **124**, **125** of the resonator element **12** on the one hand and of the capacitor elements **106**, **107** of the housing **10** on the other hand even further. Multiple capacitor elements **123**, **124**, **125** of the resonator element **12** hence may be arranged to intermesh with multiple capacitor elements **106**, **107** of the housing **10**. The capacitor elements **123**, **124**, **125**, **106**, **107** of the resonator element **12** and of the housing **10** herein alternate when viewed in the radial direction (perpendicular to the longitudinal axis L).

Another embodiment of a resonator element **1** is shown in FIG. **3**A, **3**B. In this embodiment, two capacitor elements **123**, **124** extending circumferentially about the longitudinal axis L of the resonator element **12** are arranged at the second end **121** of the resonator element **12**, wherein an outer capacitor element **124** is connected to an inner capacitor element **123** via a base **127** at a side of the capacitor elements **123**, **124** facing the second housing wall **101**. The capacitor elements **123**, **124** extend from the base **127** towards the first, bottom housing wall **100**. Via the inner capacitor element **123** the base **127** is connected to the shaft **128** of the resonator element **12**.

The capacitor elements **123**, **124** of the resonator element **12** form a groove-like opening in-between them into which a capacitor element **106** of the housing **10** extends. The capacitor element **106** is connected via a circumferential base **108** to the side walls **102**, **103**, **104**, **105** of the housing **10** and hence is carried by the side walls **102**, **103**, **104**, **105** of the housing **10** (see FIG. **3**B). The base **108** extends in a plane perpendicular to the longitudinal axis L, and from the base **108** the capacitor element **106** extends upwardly towards the second housing wall **101** into the groove-like opening formed in-between the capacitor elements **123**, **124** on the second end **121** of the resonator element **12**. The base **108** forms an opening **109** through which the resonator element **12** extends with the capacitor element **123** formed on the second end **121** of the resonator element **12**.

Another embodiment of a cavity resonator **1** is shown in FIG. **4**A, **4**B. In the embodiment of FIG. **4**A, **4**B two capacitor elements **123**, **124** are arranged on the second end **121** of the resonator element **12**. The capacitor elements **123**, **124** are connected to each other via a base **127** extending in a ring-like fashion in a plane perpendicular to the longitudinal axis L of the resonator element **12**, as it is shown in FIG. **4**B.

The base **127**, in the embodiment of FIG. **4**A, **4**B, divides the capacitor elements **123**, **124** of the resonator element **12** into two portions **123**A, **123**B, **124**A, **124**B. Namely, an upper portion **123**A, **124**A of each capacitor element **123**, **124** extends from the base **127** towards the second housing wall **101** and forms a groove-like opening extending circumferentially about the longitudinal axis L into which a capacitor element **106** connected to the second housing wall **101** extends, similarly as it has been described for the embodiment of FIGS. **1**A, **1**B and **1**C. In addition, a lower portion **123**B, **124**B of each capacitor element **123**, **124** extends from the base **127** towards the first housing wall **100** and hence towards the bottom of the cavity **11**, wherein via

the lower portion **123**B of the inner capacitor element **123** the base **127** is connected to the shaft **128** of the resonator element **12**.

Via the outer capacitor element **124** of the resonator element **12** an (increased) capacitance in-between the second, open end **121** of the resonator element **12** and the surrounding side walls **102-105** of the housing **10** in the vicinity of the second, open end **121** is provided. Namely, the outer capacitor element **124** faces with its upper and lower portion **124**A, **124**B the side walls **102**, **103**, **104**, **105** of the housing **10** with a gap G similar or equal to the gap G in-between the capacitor element **106** of the second housing wall **101** and the capacitor elements **123**, **124**.

Modifications of the embodiments described above are conceivable.

For example, in the embodiment of FIG. **4**A, **4**B an additional capacitor element of the housing **10** may be connected via a base to the side walls **102**, **103**, **104**, **105** (similar as shown in FIG. **3**A, **3**B) and may reach into the opening formed in-between the lower portions **123**B, **124**B of the capacitor elements **123**, **124** of the resonator element **12**.

It further is conceivable to use different numbers of capacitor elements on the resonator element **12** as well as on the housing **10**. Multiple capacitor elements of the resonator element **12** and the housing **10** herein are arranged to intermesh with each other such that, when viewed in the radial direction radially to the longitudinal axis L a gap G is formed in-between neighboring capacitor elements.

The idea underlying the invention is not limited to the embodiments described above, but may be implemented in an entirely different fashion in entirely different embodiments.

LIST OF REFERENCE NUMERALS

1, **1**A-**1**D Microwave cavity resonator
10 Cavity housing
100, **101** Housing wall
102-105 Side wall
106, **107** Capacitor element
108 Base
109 Opening
11 Cavity
12 Resonator element
120, **121** End
122 Central opening
123-125 Capacitor element
123A, **123**B, **124**A, **124**B Portion
126, **127** Base
128 Shaft
13 Tuning device
130 End
131 Shaft
132 Screw nut
2 Microwave filter
20 Input port
21 Output port
D Distance
G Gap
L Longitudinal axis

The invention claimed is:

1. A microwave cavity resonator, comprising:

a cavity housing forming a cavity, the cavity housing comprising a first housing wall and a second housing wall opposite the first housing wall, and a resonator element arranged in the cavity and extending longitudinally along a longitudinal axis, wherein the resonator element comprises, when viewed along the longitudinal axis, a first end connected to the first housing wall and a second end opposite the first end, the second end being arranged at a distance from the second housing wall,

wherein the resonator element, at the second end thereof, comprises at least one first capacitor element and the cavity housing comprises at least one second capacitor element reaching into the cavity and arranged at a distance, when viewed along a direction perpendicular to the longitudinal axis, from the at least one first capacitor element such that a gap between the at least one first capacitor element and the at least one second capacitor element is formed;

wherein a shaft of a tuning device is arranged coaxially to the at least one first capacitor element and the at least one second capacitor element and reaches into an opening formed at the second end of the resonator element.

2. The microwave cavity resonator according to claim **1**, wherein the at least one first capacitor element and the at least one second capacitor element are arranged coaxially to each other.

3. The microwave cavity resonator according to claim **1**, wherein the at least one first capacitor element and the at least one second capacitor element extend about the longitudinal axis.

4. The microwave cavity resonator according to claim **1**, wherein the resonator element comprises multiple first capacitor elements.

5. The microwave cavity resonator according to claim **1**, wherein the cavity housing comprises multiple second capacitor elements.

6. The microwave cavity resonator according to claim **1**, wherein, when viewed along the direction perpendicular to the longitudinal axis, one of the at least one second capacitor element is arranged spatially in between two first capacitor elements.

7. The microwave cavity resonator according to claim **1**, wherein one of the at least one first capacitor element is arranged spatially in between two second capacitor elements.

8. The microwave cavity resonator according to claim **1**, wherein the at least one second capacitor element is arranged on the second housing wall and extends from the second housing wall into the cavity.

9. The microwave cavity resonator according to claim **1**, wherein the at least one second capacitor element is arranged on a side wall of the cavity housing extending in between the first housing wall and the second housing wall.

10. The microwave cavity resonator according to claim **1**, wherein the at least one first capacitor element comprises multiple first capacitor elements that are connected to each other via a first base extending along a plane perpendicular to the longitudinal axis.

11. The microwave cavity resonator according to claim **10**, wherein the multiple first capacitor elements extend from the first base towards at least one of the second housing wall and the first housing wall.

12. The microwave cavity resonator according to claim **10**, wherein a first portion of the at least one first capacitor element extends from the first base towards the second housing wall and a second portion of the at least one first capacitor element extends from the first base towards the first housing wall.

13. The microwave cavity resonator according to claim **1**, wherein the at least one second capacitor element comprises multiple second capacitor elements that are connected to each other via a second base extending along a plane perpendicular to the longitudinal axis.

14. The microwave cavity resonator according to claim **1**, wherein the tuning device is arranged at the second housing wall, wherein the shaft of the tuning device extends into the cavity along the longitudinal axis, wherein a position of the shaft is adjustable along the longitudinal axis in order to tune the microwave cavity resonator.

15. The microwave cavity resonator according to claim **1**, wherein the cavity housing is made of a metallic first material, and the resonator element is made of a different, second material.

16. The microwave cavity resonator according to claim **15**, wherein the metallic first material comprises aluminum, and wherein the different, second material comprises brass.

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